

# First round comments from the Ad-hoc review committee (Maurik Holtrop, Kevin Giovankl, Zein-Eddine Meziani)

September 10, 2018

Dear Mohammad Hattawy,

We have reviewed your paper, "First exclusive Deeply Virtual Compton Scattering measurement off bound nucleon in  $^4\text{He}$ ", and have compiled an initial set of comments.

First, we think these are interesting results, and we think that the paper is fairly well written.

We would like to ask for some clarification on several points, and suggest that these are addressed in the paper. The following list is loosely arranged in order of importance:

1. For figure 6, you state that "our experiment shows a sharp drop" (line 250), in the incoherent  $A_{LU}/\text{proton } A_{LU}$ . You do indeed have a single point, at the lowest  $x_B$ , that is lower than the other three, but it seems that I can draw a straight horizontal line through all 4 error bars. It seems too strong a statement to speak of a sharp drop here, and subsequently conclude that there is "strong quenching of the BSA" (line 253). If I contrast this graph with figure 5, where you state that " $A_{LU}$  does not indicate a strong dependence on  $Q^2$ ", I agree with you. The variation between the point in figure 5 is however similar to that in figure 6, except the order of the variation is different.

We replaced the figure with the t-dependence, and changed the wording in the text accordingly. We believe t-dependence better reflects difference between the free and bound nucleon structures, and shows clear difference with existing theoretical models.

2. To further consider this statement, I looked up ref. 21, which contains the proton data that you divide by. This data is not, however, shown as a function of  $x_B$ , but in a set of tiles, with variation in -t shown for different  $x_B$  and  $Q^2$  average values. It is then not quite clear how you used this data to get the data points to divide out the proton  $A_{LU}$ . How closely do the kinematics agree? How does this procedure affect the systematic uncertainties? This is important information to make a judgement on the validity of your figure 6.

The ratio of  $A_{LU}$ s were derived in two ways, in the first method we studied and parameterized  $x_B$ ,  $Q^2$ , and t-dependences of free proton  $A_{LU}$  from ref [21]. Then using this parametrizations we calculated  $A_{LU}$ s for free proton at kinematic points of our data. In the second method we selected events in our analysis such that kinematics of selected events matched kinematics of the free proton points for the t-dependence of the ratio. In the figure we use results of the first method since statistics is higher for our data. The difference in

ratios calculated with these two methods was taken as systematic error for the ratio. The details can be found in the analysis note (appendix J).

3. The paper makes no mention of the initial momentum of the struck nucleon, which I would expect to smear out the kinematics. It would be useful for the reader to get an impression on how large this effect would be. Does this explain the widths of the distributions in figure 2, or are these widths dominated by detector resolution?

We have studied this effect, we updated the paper to address the question. Of relevance to this question, the appendix H in the analysis note looks in more details into alternative kinematics to solve the issue. However, final results did not appear to be affected by any of the alternate choices, confirming the small impact of the Fermi momentum smearing.

4. There is also no mention of final state interactions in the paper. It is not obvious to me that the FSA should be zero for a beam spin asymmetry on  $^4\text{He}$ . If you have a calculation that shows this is the case, it would be good to mention it.

There are no such theoretical calculations of the FSI on the incoherent DVCS asymmetries on the  $^4\text{He}$ . A statement has been added toward the end to address this point.

There are also number of minor initial edits and stylistic suggestions that we would like you to consider. This list is in chronological order:

1. In the title, add an "a": "Deeply Virtual Compton Scattering off a bound proton", or make proton plural (protons).  
Updated. "protons"
2. First sentence of abstract, does "measurement of incoherent deeply virtual..." work better?  
Updated.
3. Third sentence, replace "have been compared" with the more active "are compared"  
Replaced.
4. Line27: leave out "the fact"  
Cleaned.
5. Rephrase line 34. Perhaps: "correlations can be revealed"  
Cleaned.
6. Line 46 - 49: Perhaps make it more clear that in the coherent case the scattering is off the entire nucleus, and that for the incoherent case the nucleon is ejected? Is that a correct interpretation of what is going on?  
Updated.
7. Line 78: "amplitude that contains", or make amplitude plural.  
Cleaned.
8. Line 154, you do not define what was used for  $t_{min}$ , and how it was determined.  
The definitions is added.
9. Line 206: To make it more clear to the reader what you are doing with the data, you should explicitly state that you make a fit of the  $\phi$  distributions, and then extract the  $a_0$  value as  $A_{LU}(90)$ . You should also explicitly state that when plotting versus one kinematic variable, you integrate over all the other kinematic variables. This relates to comment #2 above.  
Cleaned.
10. Line 207: "Fig 4 presents ..." and line 215: "We present in Fig 5". One is passive, the other active. It is probably better to choose one or the other, but not mix them.  
Cleaned.
11. Line 221: Either "Their model uses a nuclear spectral function" or "Their model uses nuclear spectral functions".  
Cleaned.
12. Line 238: -> "on a free proton target".  
Corrected.
13. Line 241: "ratios show 20%-40% lower asymmetries" (drop "a")  
Corrected.
14. Line 243: rewrite to not have "effect" twice in the sentence so close together.  
Cleaned.

15. Line 260: Rewrite your last sentence. Suggestion: "This surprising result opens a new avenue for progress in understanding quarks and gluons in the nuclear medium."  
[Added.](#)